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ABSTRACT

The National Center on the Educational Quality of the Workforce's National Employer Survey represents a unique source of information on how employers recruit workers, organize work, invest in physical capital, and use education and training in the workplace. The U.S. Bureau of the Census administered it as a telephone survey to a nationally representative sample of private establishments with more than 20 employees in both the manufacturing and nonmanufacturing sectors. Of the 3,358 establishments contacted, completed surveys were received from 1,621 manufacturing firms and 1,324 nonmanufacturing firms. Findings indicate that most employers provide some type of formal training program. Employers who have adopted some characteristics of "high performance work systems" and have made large investments in physical capital or have hired workers with higher average educational level are more likely to train workers within their establishment. Most employers are more likely to provide specific training, such as orientation for new workers, health and safety, and new methods or procedures training, rather than numeracy, literacy, and basic education. The type of training program offered varies considerably by employer size and industry. The determinants of the proportion of workers trained look similar to those of the probability of offering formal training. The impact of training investments by employers differs according to their nature, timing, and location. (Contains 16 references.) (YLB)

EQW WORKING PAPERS

Beyond the Incidence of Training: Evidence from a National Employer Survey

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Contents

Abstract

This paper seeks to provide new insight into how school and post-school training investments are linked to employer workplace practices and outcomes. Our observations are based on a unique, nationally representative survey of establishments in the United States: the National Center on the Educational Quality of the Workforce's National Employer Survey (EQW-NES).

Our research went beyond simply measuring the incidence of formal and informal training to examine the determinants of the types of training in which employers invest, the relationship between formal school- and employer-provided training, who is receiving training, the links between investments in physical and human capital, and the impact that human capital investments have on the productivity of establishments. We found that the smallest of employers are much less likely to provide formal training programs than employers with larger establishments. Regardless of size, employers who have adapted some of the practices associated with what have been called "high-performance work systems" are more likely to have formal training programs. Employers who have made large investments in physical capital or who have hired workers with higher average educational levels are also more likely to invest in formal training and to train a higher proportion of their workers, especially in the manufacturing sector. Significant and positive effects on establishment productivity are associated with investments in human capital. Employers who hire better educated workers have appreciably higher productivity. Finally, the impact of employer provided training differs according to the nature, timing, and location of the employer's investments.

Introduction

The increase in international competition, new technologies such as information technology, and changing work organization have contributed to a growing debate in the United States about the ways in which workers accumulate skills relevant to the rapidly evolving workplace. Historically, the United States has relied on a system of formal school-based learning, combined with informal learning on the job, to supply the necessary skills for the workplace. Although this system appeared capable of adequately supplying the human capital needs of most firms through the 1960s, there is growing concern that this system is not sufficient to meet the current needs of employers. Now more than ever, the need to acquire new skills does not stop once individuals leave school; instead, workers need to be taught by schools to "learn how to learn" so that they can continue to develop new skills throughout their working lives. In addition, once in the workplace, workers need to find ways to obtain skills (those associated with information technology or new work practices, such as total quality management, or TQM) that are not easily obtained informally on the job. In the past, much of the research on the impact of human capital accumulation focused on the impact of pre-employment investments in human capital (i.e., schooling) on subsequent labor market experience. This paper attempts to provide new insight into the post-school human capital investment experience and how both school and post-school human capital investments are linked to employers' workplace practices and outcomes. Our observations are based on a unique, nationally representative survey of establishments in the United States: the National Center on the Educational Quality of the Workforce's National Employer Survey (EQW-NES).

Before examining evidence from this new survey of employers, it is useful to put the discussion of investments in human capital into perspective. Annual investments in human capital in the United States are large. For example, during 1990, more than $377 billion (in 1989 dollars) was spent on K-12 and public and private higher education (National Center for

Education Statistics 1993). At the same time, Carnevale (1990) estimated in 1986 that at least $32 billion was spent annually on firm-provided formal training in the United States. Constructing precise estimates, however, on the actual annual training expenditures paid out by firms is difficult. For example, the training expenditures referred to by Carnevale have not been updated since 1986, and other researchers have argued that annual expenditures on formal training by firms could be as high as $148 billion or even double this figure if informal training costs are included (see Mincer 1988 and Lynch 1995). As a comparison, total non-farm expenditures on new plants and equipment in the United States in 1990 were slightly more than $590 billion. Therefore, large investments are made annually in both human and physical capital.

The problem in the current policy debate on workforce preparedness is that these aggregate measures of expenditures on education and training do not reveal much about the types of training in which employers choose to invest, the relationship between formal schooling and employer-provided training, who is receiving training, the links between investments in physical and human capital, and the impact that human capital investments have on the productivity of establishments. Employers must continually decide whether to make additional investments in training within their establishments or to purchase skills from the outside. Employers' investment decisions also are influenced in part by the characteristics of the workers they employ. Employees who are perceived to have higher turnover rates are less likely to receive employer-provided training. At the same time, employees who have already shown an aptitude to learn new skills by having completed more years of schooling may then be more likely to receive additional human capital investments provided by an employer. How employer investments in human capital are related to investments in physical capital is not clear *a priori*. On the one hand, some employers may view investments in physical capital as a way to substitute for skilled labor; on the other hand, some may view investments in human capital as complements to investments in new physical capital. Finally, investments in human capital are costly, and employers need to assess the impact of their investment strategies on productivity.

The EQW-NES allows us begin to examine these kinds of issues and to move beyond simply measuring the incidence of post-school training. In this paper, we begin by summarizing the characteristics of employer-provided training as found in the EQW-NES. We then examine the determinants of the probability of employer-provided formal training programs, the determinants of offering different types of training programs (e.g., teamwork and computer skills training), and the factors linked to the proportion of workers trained in an establishment. In particular, our analysis focuses on how employers' post-school training investments are related to their investments in physical capital and the level of education of their workers. We then develop a simple model of the impact of human capital investments on establishment productivity and conclude with a summary of results and an outline for future research.

The Survey

The EQW-NES (designed by Lisa Lynch in collaboration with EQW Co-Directors Robert Zemsky and Peter Cappelli) was administered by the U.S. Bureau of the Census as a telephone survey in August and September of 1994 to a nationally representative sample of private establishments with more than 20 employees. The survey represents a unique source of information on how employers recruit workers, organize work, invest in physical capital, and use education and training investments. The survey goes one step beyond many previous surveys of workplace practices by collecting information that allows us to examine the impact that all of these factors have on the productivity of establishments and the wages of workers. In addition, the survey is structured to provide information on all categories of incumbent workers, not just new hires or those in core occupations.

The survey over-sampled establishments in the manufacturing sector and establishments with more than 100 employees. Public sector employers, not-for-profit institutions, and corporate headquarters were excluded from the sample. Although the survey excluded establishments with less than 20 employees (which represent about 85 percent of all establishments in the United States), the sampling frame represents establishments that employ about 75 percent of all workers. This is because, while most establishments are small (with less than 5 employees), most workers are employed in larger establishments. Since the focus of our research was on the intersection between employers' practices and employees' human capital experiences, we decided to concentrate on those establishments employing the most employees. The target respondent in the manufacturing sector was the plant manager and in the non-manufacturing sector was the local business site manager. The survey was designed, however, to allow for multiple respondents, so that information could be obtained from establishments that kept financial information, such as the book value of capital or the cost of goods and materials used in production, at a separate finance office (typically at corporate headquarters for multi-establishment enter-

prises). Computer-assisted telephone interviewing was used to administer each survey, which took about 28 minutes to complete.

The sampling frame for the survey was the Bureau of the Census SSEL file, one of the most comprehensive and up-to-date listings of establishments in the United States. Of the 4,633 eligible establishments contacted by the Census bureau, 1,275 refused to participate in the survey. This represents a 72 percent response rate, which is substantially higher than the rate for many similar establishment surveys.[1] The usual reasons given by employers for refusal to participate in the survey were that they did not participate in voluntary surveys and that they were too busy to participate. Probit analysis (available from the authors on request) of the characteristics of non-respondents indicates that there was no significant pattern at the two-digit industry level for the likelihood of participating in the survey. The only businesses more likely not to participate were manufacturing establishments with more than 1,000 employees. Of the 3,358 establishments that participated in the survey, not all respondents completed all parts of the survey by the interview cut-off date of October 1, 1994. The final number of surveys for which all parts were completed was 1,621 from establishments in the manufacturing sector and 1,324 from establishments in the non-manufacturing sector. This represents a 64 percent overall completed survey response rate. The results presented in the following sections refer to this final sample of 2,945 establishments (see Appendix A for more details on the response rates, Appendix B for the distribution of establishments by industry, and Appendix C for the distribution of establishments by employer size, weighted and unweighted).

The Incidence and Distribution of Training

Table 1 reports the incidence of both formal and informal training by establishment size for the weighted sample of establishments. Most establishments (81 percent) offer some type of formal training. More than 57 percent of establishments reported that, since 1990, the amount of formal training has increased; 41 percent reported no change in the amount of formal training; and only 2 percent of employers reported decreased amounts of formal training during this same period. There is some variation in the incidence of training by establishment size, with smaller establishments (less than 100 employees) much less likely to offer formal training than the largest establishments (more than 1,000 employees). Therefore, the incidence of training in the U.S. is high and has been growing through the 1990s for most employers. *Formal training* in this survey was defined as structured training that was offered at the establishment or at another location and that occurred during working hours or at other times. Structured training included all types of training activities that had a predefined objective. Examples of structured or formal training included seminars, lectures, workshops, audiovisual presentations, apprenticeships, and structured on-the-job learning. In addition, the respondents were asked about the incidence of unstructured or *informal training*. In this type of training, employees learn by observing others doing the job, or they are shown how to do a job in an informal one-on-one situation by supervisors, co-workers, or others. Virtually every establishment in the survey reported providing this type of training. Therefore, variation in the simple measure of the incidence of informal training does not help us to understand differences in training practices across employers.

Table 2 reports the incidence of formal training by industry. Although the overall incidence of formal training is high, there is considerable variation by industry. For example, in the manufacturing sector, only 61 percent of establishments in the textile and apparel sector offer some type of formal training program, compared with more than 87 percent of establishments in the chemical, petroleum, and primary

Table 1
Incidence of Formal or Informal Training by Size of Establishment†

Number of Employees	Formal Training	Informal Training
All Establishments	81%	97%
20-49	75%	96%
50-99	82%	99%
100-249	90%	98%
250-999	90%	99%
More Than 1,000	99%	98%

† Table data are weighted means.

metals sectors. In non-manufacturing, more than 95 percent of establishments in communications, utilities, finance, and insurance offer formal training programs, while only 70 percent of establishments in transportation services and wholesale trade offer formal training programs. Overall, the incidence of formal training programs appears to be higher in the non-manufacturing than in the manufacturing sector.

These findings are similar to those reported by the Bureau of Labor Statistics (BLS) in a survey of approximately 12,000 establishments conducted in January 1994. The BLS found that 71 percent of establishments offer formal training programs. The fact that the BLS reported an incidence level that is lower than that found in the EQW-NES is most likely due to the fact that the BLS sample also included employers with less than 20 employees. These employers are much less likely to offer formal training than those covered in the EQW-NES sample. However, if we compare the incidence of formal training for employers with more than 50 employees reported in the BLS survey with that reported in the EQW survey, the BLS number is higher. This probably reflects that fact that the surveys are worded differently, and the fact that the BLS survey was a mailed survey, while the EQW-NES survey was conducted by telephone. Nevertheless, the general

patterns of the incidence of training by employer size and industry are similar in both surveys.

Because the EQW-NES has detailed information on establishment characteristics, worker characteristics, and workplace practices, it is possible to see how all of these factors together affect the probability that an establishment will provide formal training programs. Table 3 presents logit maximum likelihood estimates of the impact these variables have on the probability of an employer providing any type of formal training program. The establishment characteristics include: number of employees (categorized by five size classes, omitting establishments with more than 1,000 employees); a dummy variable equal to one if the establishment is part of a multi-establishment enterprise or firm; a dummy variable equal to one if employment at the establishment has gone up over the past three years; a dummy variable equal to one if employment at the establishment has gone down over the past three years; and 21 two-digit industry controls (the sector groupings shown in Table 2). Because the survey also collected information on the book value of the capital stock, it is possible to include the capital/labor ratio to see if employers with greater investments in physical capital are more or less likely to invest in the human capital of their employees.

Worker characteristics include: a dummy variable equal to one if the employer reported that more than 25 percent of workers were less than fully proficient in their current jobs; an establishment average educational level, which was constructed by calculating the weighted average across five occupational categories of average years of education in each occupation[2]; the percentage of employees working at the plant for less than one year; a dummy variable equal to one if the employer reported that the skills required to perform

Table 2
Incidence of Formal Training by Industry†

Industry	Percentage Offering Formal Training
All	**81%**
Manufacturing Sector	
Food and Tobacco	75%
Textile and Apparel	61%
Lumber and Paper	76%
Printing and Publishing	78%
Chemicals and Petroleum	88%
Primary Metals	87%
Fabricated Metals	72%
Industrial Machinery, Electronic Equipment, and Instruments	74%
Transportation Equipment	77%
All Other Manufacturing	78%
Non-Manufacturing Sector	
Construction	79%
Transportation	70%
Communication	94%
Utilities	100%
Wholesale Trade	71%
Retail Trade	83%
Finance	96%
Insurance	95%
Hotels	77%
Business Services	79%
Health Services	79%

† Table data are weighted means.

Table 3

Determinants of the Probability of Providing Formal Training Programs†

	Manufacturing		Non-Manufacturing	
Variable Names	***Estimate***	***t-test***	***Estimate***	***t-test***
Establishment Characteristics				
Log [Capital/Labor]	0.24	2.60**	0.14	1.76*
Fewer Than 49 Employees	-1.55	-2.06**	-2.03	-2.21**
50-99 Employees	-0.99	-1.36	-1.96	-2.19**
100-249 Employees	-0.99	-1.41	-1.22	-1.37
250-999 Employees	-0.58	-0.84	-1.20	-1.35
Multi-Establishment Firm	0.02	0.09	-0.09	-0.27
Employment Up	0.19	0.62	0.19	0.56
Employment Down	-0.32	-0.94	0.39	0.90
Industry Controls	yes		yes	
Worker Characteristics				
Low Proficiency	-0.17	-0.58	0.10	0.29
Average Education	0.42	1.86*	0.23	1.27
% Workers < 1 yr.	-0.01	-1.08	0.001	0.13
Skills Demand Up	0.96	3.53**	0.55	1.77*
% Non-Managerial Workers Using Computers	-0.0005	-0.10	-0.003	-0.74
% Minorities	-0.003	-0.674	-0.01	-2.53**
% Women	0.01	1.79*	0.01	1.37
% Production Workers	0.04	2.40**	-0.02	-1.09
% Supervisory Workers	0.03	0.87	-0.04	-1.07
% Technical Workers	0.04	1.76*	-0.02	-0.74
% Clerical/Sales Workers	0.05	2.12**	-0.03	-1.56
Unionized	0.41	1.30	0.29	0.68
Workplace Practices and Characteristics				
Use Benchmarks	0.79	2.22**	0.22	0.56
Use TQM	1.70	5.42**	0.77	1.85*
Have Job Sharing	-0.23	-0.76	-0.32	-1.00
% Workers Rotated	0.004	0.95	-0.002	-0.34
% Workers in Self-Managed Teams	-0.005	-0.92	-0.007	-1.16
# Organizational Levels	0.04	0.45	-0.04	-0.36
# Employees per Supervisor	-0.0005	-0.05	-0.001	-0.14
Research & Development	0.11	0.37	0.80	1.70*
Export	0.35	1.30	0.06	0.16
Birth Year of Establishment	-0.002	-0.32	0.01	1.42
(Equation also includes a constant.)				
Number of Observations	890.0000		624.0000	
Log Likelihood	-232.7000		-166.2300	
Pseudo R^2	0.3169		0.2264	

† Logit maximum likelihood estimates.

* Significance at the 10% level.

** Significance at the 5% level.

tasks at the plant had increased over the past three years; the percentage of non-managerial workers who used computers in their jobs; the percentage of employees who were minorities or women; a dummy variable equal to one if any part of the plant or business site was unionized; and the percentage distribution of employment by five occupational categories ("managerial and professional workers" is the omitted category).

Finally, proxies for workplace practices include: dummy variables equal to one if the employer reported using benchmarking or TQM; a dummy variable equal to one if the employer allowed job sharing; the percentage of workers rotated across jobs; the percentage of workers in self-managed teams; the number of organizational levels within the plant; and the number of employees per supervisor. Although the original sample size of completed interviews in the manufacturing sector was 2,945 businesses, the logit analysis uses a smaller sample of 890 manufacturing and 624 non-manufacturing establishments. This is because data are missing on several of the explanatory variables, especially ... book value of capital stock.

As shown in Table 3, businesses that employ less than 50 workers in manufacturing and less than 100 employees in non-manufacturing are much less likely to provide formal training programs to their workers than are larger establishments. In addition, establishments with a higher capital/labor ratio are more likely to provide formal training programs. The industries less likely to report employer-provided formal training programs, everything else constant, include textile and apparel, construction, transportation services, wholesale and retail trade, insurance, hotels, and business services. None of the remaining establishment characteristics were significant.

Significant worker characteristics in the manufacturing sector include the average educational level of the establishment's employees, the percentage of women employees, a dummy variable on increased skills demand, and the proportion of workers who are production, technical, or clerical/sales workers. All of these factors raise the probability of providing formal training programs. In non-manufacturing, increasing skill demands raises the probability of providing formal training, while a higher percentage of minority employees is linked to a lower probability of providing formal training programs.

The results shown in Table 3 provide some evidence on the complementarity of investments in education and employer-provided training. Establishments with more highly educated workers are also more likely to provide additional human capital to their employees. Although some studies using household data have found that the probability of women receiving formal training is lower than for men, Table 3 suggests the opposite result (in the manufacturing sector). Female employment is relatively low in the manufacturing sector as a whole; therefore, employers who hire disproportionately more women may need to provide more training because women are less likely to have had as much work experience in this sector.

Employers who use benchmarking or have introduced TQM into their establishments are also more likely to provide formal training, everything else constant. Both TQM and benchmarking require workers to take on more responsibilities for quality control and problem solving. These skills are probably more difficult for workers to acquire informally, so employers need to develop formal training programs to meet these skill needs. With the exception of research and development in the non-manufacturing sector, none

of the remaining workplace practices have a significant impact on the probability of providing any type of formal training program.

In summary, most employers provide some type of formal training program, although there is substantial variation by size and industry in the probability of providing formal training. In particular, even after controlling for a variety of worker and establishment characteristics, the smallest of employers are much less likely to provide formal training programs. This may be because smaller employers face higher per-unit costs in the provision of formal training due to high initial set-up costs, or they may have more concerns about losing trained employees to competitors.

However, the survey is unable to establish the reasons why smaller employers are less likely to provide training. Regardless of size, employers who have adopted some of the characteristics of high-performance work systems (e.g., TQM or benchmarking) are much more likely to have formal training programs. In addition, employers who have made large investments in physical capital relative to the number of workers or who have hired workers with higher average educational levels are more likely to train workers within their establishments. This suggests that employer-provided training is a complement to rather than a substitute for investments in physical and human capital. There is some evidence of a virtuous circle of investment in human capital: employee investments in schooling are further augmented by employer investments in training. The complementarity between training and physical capital is also an important finding. Concerns in the United States about the replacement of skilled workers with high-technology machines and low-skilled workers do not appear to be well-founded.

Types of Training Programs Offered

Since such a high percentage of employers report offering formal or informal training programs, measuring the incidence of training does little to provide insight into the heterogeneity of training experiences across employers. In fact, the raw incidence numbers suggest that there is little evidence of a problem in the provision of post-school training. Yet there seems to be a perception in both the public policy arena and the private sector that there is under-investment in training in the United States. If the incidence of training does not look low, perhaps examining different dimensions of training, such as the content of training programs offered by employers, may shed some light on the nature of the perceived training problem in the United States. Figure 1 shows the percentage of establishments engaged in 13 different types of training programs. More than three-quarters of all establishments report financing or providing new-hire orientation, health and safety, and new methods or procedures training. About two-thirds offer cross-training, sales and customer service training, and managerial and supervisory training. More than half of the employers provide computer skills training, teamwork training, or tuition reimbursement, while only slightly more than one-quarter of employers offer literacy, numeracy, or basic education training.

As we saw in our examination of the incidence of training, however, there is even further variation in the types of training programs offered by industry. For example, more than 80 percent of establishments in sectors such as utilities, finance, insurance, chemicals, and petroleum products report offering computer skills training. Yet, only 30 percent of establishments in the retail sector offer this type of training. Literacy, numeracy, and basic education training is offered by few employers in the business services, retail, or construction sectors (less than 20 percent); however, more than 50 percent of employers in utilities, finance, insurance, and primary metals offer this type of training. More than 75 percent of establishments in the utilities, finance, insurance, chemicals, and petroleum products industries pay for or provide

teamwork training, and only 35 percent of employers in the construction industry offer this type of training.

Table 4 presents estimates on the probability that an employer would pay for or provide four different types of training programs: computer training, teamwork training, basic education, and sales and customer service training.[3] The analysis is again purely descriptive, and we group our explanatory variables into the same categories used in Table 3: establishment characteristics, worker characteristics, and workplace practices. We already have seen in Table 3 that smaller employers are less likely to offer formal training programs than larger employers, and this applies to most training types as well. This effect appears to be modified somewhat if the small establishment is part of a multi-establishment firm. In this case, the establishment is more likely to provide formal training programs. This may be due to the fact that multi-establishment enterprises can lower the fixed costs of training for their smaller locations by spreading these costs over a number of establishments.

The only type of training program for which there is no significant size effect is sales and customer service training. There is considerable variation in the impact of industry on the probability of offering different training types. Not surprisingly, establishments in the retail and hotel sectors are much more likely to provide sales and customer service training than establishments in any other industry. At the same time, there is no significant variation by industry in the probability of offering teamwork training, and there are no significant and positive industry effects for the probability of offering basic education. For computer training, the sectors that include transportation services, retail, hotels, business services, and health services are all less likely to provide this type of training. However, establishments in the chemical and petroleum products or utilities sectors are significantly more likely to offer computer training, everything else being constant.

Figure 1

Percentage of Establishments Engaged in Certain Types of Training

Type of Training	Percentage of Establishments
Literacy/Numeracy	25.1%
Tuition Reimbursement	47.5%
Computer Literacy	51.5%
EEO or Diversity/Sensitivity	51.5%
Team Work or Problem Solving	54.9%
Executive Development	62.7%
Line Supervisory Skills	65.3%
Sales or Customer Service	68.3%
Cross Training	68.5%
Production or Equipment	68.5%
New Worker Orientation	73.9%
New Methods/Procedures	76.1%
Health and Safety	81.2%

Under the category of worker characteristics, we find that a higher average educational level of workers at an establishment is positively linked to the provision of computer and teamwork training. At the same time, higher employee turnover tends to lower the probability of providing most types of training programs. The higher the percentage of minority workers at an establishment, the lower is the probability of providing computer training; and a greater proportion of female employees appears to be positively related to the provision of sales and customer service training. Finally, the greater the proportion of technical workers in an establishment, the more likely the establishment is to provide teamwork training.

New workplace practices associated with high-performance work systems such as TQM and benchmarking appear to be linked with more general types of training programs, such as computer training, teamwork training, and basic education. Finally, employers who report that they have increased training during the past three years appear to be offering more of all types of training, rather than any single type of training program.

In summary, most employers are more likely to provide specific training, such as new-hire orientation, health and safety, and new methods or procedures training, than numeracy, literacy, and basic education. The type of training program offered varies considerably by employer size and industry. When we estimate a descriptive logit on the probability of offering each of four different types of training programs, we see that smaller employers are less likely to offer computer, teamwork, or basic education training. In addition, average educational level and new workplace practices are positively related to higher skill development, such as computer and teamwork training.

Table 4

Determinants of Probability of Offering Training by Type†

Variable Name	*Type of Training‡* Computer Training	Teamwork Training	Basic Education	Sales and Customer Service
Establishment Characteristics				
20-49 Employees	-1.38**	-1.31**	-0.85**	-0.31
	(-4.76)	(-5.04)	(-4.05)	(-1.41)
50-99 Employees	-1.16**	-1.29**	-0.89**	-0.34*
	(-4.14)	(-5.16)	(-4.45)	(-1.70)
100-249 Employees	-0.72**	-1.05**	-0.41**	-0.09
	(-2.67)	(-4.38)	(-2.28)	(-0.47)
250-999 Employees	-0.38	-0.82*	-0.33**	-0.13
	-1.46)	(-3.56)	(-2.06)	(-0.76)
Multi-Establishment firm	0.35**	0.30**	0.29**	0.16
	(2.69)	(2.50)	(2.42)	(1.33)
Employment Up	0.31**	-0.04	0.07	0.17
	(2.21)	(-0.28)	(0.58)	(1.30)
Employment Down	0.29*	0.12	0.23*	-0.03
	(1.71)	(0.80)	(1.64)	(-0.21)
Industry Controls	yes	yes	yes	yes
Worker Characteristics				
Low Proficiency	0.18	-0.09	0.26**	0.06
	(1.28)	(-0.69)	(2.36)	(0.50)
Average Education	0.14*	0.17**	-0.03	0.09
	(1.73)	(2.43)	(-0.50)	(1.28)
% Workers < 1 yr.	-0.01**	-0.003	-0.01**	0.003
	(-2.50)	(-0.75)	(-2.50)	(0.75)
Skills Demand Up	0.58**	0.56**	0.37**	0.36**
	(4.46)	(5.09)	(3.08)	(3.00)
% Non-Managerial	0.01**	-0.0004	0.001	0.003*
Workers Using Computers	(5.00)	(-0.20)	(0.50)	(1.76)
% Minorities	-0.01**	0.001	0.001	-0.0035*
	(-5.00)	(0.50)	(0.50)	(-1.75)
% Women	0.004	0.003	0.0005	0.009**
	(1.33)	(1.00)	(0.17)	(3.00)
% Production Workers	-0.001	0.005	0.002	-0.004
	(-0.14)	(0.83)	(0.40)	(-0.66)
% Supervisory Workers	0.003	0.005	0.0008	-0.003
	(0.03)	(0.50)	(0.08)	(-0.30)
% Technical Workers	0.005	0.013*	-0.0003	-0.003
	(0.63)	(1.86)	(-0.05)	(-0.50)
% Clerical/Sales Workers	0.01	-0.003	-0.002	0.02**
	(1.11)	(-0.43)	(-0.28)	(2.50)
Unionized	0.10	0.16	0.01	-0.30**
	(0.67)	(1.14)	(0.08)	(-2.50)

Table 4 (cont'd)

Variable Name	Type of Training‡ Computer Training	Teamwork Training	Basic Education	Sales and Customer Service
Workplace Practices and Characteristics				
Use Benchmarks	0.30**	0.45**	0.37**	0.11
	(2.00)	(3.75)	(3.36)	(0.92)
Use TQM	0.47**	1.16**	0.53**	0.25**
	(3.36)	(9.67)	(4.82)	(2.08)
Have Job Sharing	0.09	0.0004	0.14	0.21*
	(0.64)	(0.003)	(1.17)	(1.75)
% Workers Rotated	-0.004**	0.007**	0.002	-0.0008
	(-2.00)	(3.50)	(1.00)	(-0.40)
% Workers in	0.002	0.01**	0.003	0.0002
Self-Managed Teams	(0.67)	(3.33)	(1.50)	(0.10)
# Organizational Levels	0.06	0.03	0.08**	-0.01
	(1.50)	(1.00)	(2.67)	(-0.33)
# Employees per	-0.003	-0.0002	0.004**	-0.006**
Supervisor	(-1.50)	(-0.10)	(2.00)	(-2.00)
Training Increased During	0.74**	0.96**	0.60**	0.57**
Past 3 Years	(5.69)	(8.00)	(4.84)	(4.63)
Training Decreased During	0.59	0.45	0.652**	0.42
Past 3 Years	(1.38)	(1.32)	(2.10)	(1.31)
(Equations also include a constant term.)				
Log Likelihood	-878.08	-1023.64	-1232.35	-1162.21

† Probit estimates.
‡ t-test is given in parentheses; N = 2166.
* Significance at the 10% level.
** Significance at the 5% level.

Determinants of the Proportion of Workers Trained

Although the proportion of employers providing formal training programs is high in the United States, recent surveys, such as the 1991 Current Population Survey (CPS), indicate that only 17 percent of workers report that they received formal training from their employers. Therefore, although most firms provide training, relatively few workers appear to be getting it. However, the reported rate of the proportion of workers involved in formal training programs in our survey is considerably higher (more than 40 percent for the weighted sample) than the 17 percent reported in the 1991 CPS.

This higher figure in the EQW-NES has several possible explanations. First, our survey is representative of establishments with 20 employees or more in the private sector. It is not a representative survey of the workforce, as is the CPS. Since we know from Table 3 that smaller employers are less likely to provide formal training, excluding employers with less than 20 employees should mean that our estimates of the proportion of workers trained will be higher than what one would find for the economy as a whole. Second, a more recent survey of employer-reported training by Barron and colleagues (1994) found that the proportion of newly hired permanent workers who received formal training was about 28 percent. This number is probably an underestimate of the total proportion of workers trained because newly hired workers are more likely to be in higher turnover positions with a lower probability of receiving training. Third, our survey took place three years later than the CPS study, during a period of economic expansion. Unfortunately, not having a nationally representative time series database on training makes it difficult to examine the impact of the business cycle and secular trends on the incidence of training. Fourth, the nature of the survey instrument (telephone, personal interview, or mail), who the respondent was, and the reference period for the training questions could all lead to different estimates of the proportion of workers trained. Finally, Barron and colleagues (1994) found that there is considerable measurement error between rates and hours of formal

training reported by employers versus employees, with employees reporting lower rates of training than employers. We suspect that part of the problem may be that periods of training are labeled differently by workers and employers. For example, a supervisor who is assigned to work side-by-side with a new employee may view the time spent with a new hire as training, whereas the employee views the fact that the supervisor is "always hanging around" as monitoring, not training. All of this discussion suggests that our understanding of training and who receives it would be greatly enhanced by more matched employer-employee surveys and by the development of a consistent time series on employer-provided training.

Nevertheless, understanding the factors associated with the proportion of workers trained within an establishment may provide further insight into the nature of the perceived training problem in the United States. Table 5 presents tobit maximum likelihood estimates of the determinants of the proportion of workers receiving formal training within each establishment. The explanatory variables are the same as those used in Tables 3 and 4. Table 5 allows us to see which employers not only provide formal training but also train "deeply." The determinants of the proportion of workers trained look somewhat similar to the determinants of the probability of offering formal training, especially in the manufacturing sector. Establishments that use high-performance work practices, such as TQM, benchmarking, or self-managed teams, are more likely to train a higher proportion of their workers. This result is not surprising since most, if not all, workers need to be trained in order to implement a high-performance work system successfully. Those establishments in the manufacturing sector with a higher capital/labor ratio are also more likely to train a higher proportion of their workers, as are those establishments with more educated employees (although this latter effect is not quite significant at the 10 percent level for a two-tailed t-test).

One of the major differences between Tables 5 and 3 are the coefficients on establishment size. Smaller establishments do not appear less likely to train a higher proportion of their workers, conditional on training at all. This is consistent with the existence of high fixed training costs. In addition, in the non-manufacturing sector, establishments employing a higher proportion of office/clerical workers or sales/customer service or other front-line workers train a much lower proportion of their employees. These occupations in the non-manufacturing sector tend to be the jobs with the highest turnover rates. In summary, even though there is a high incidence of formal training across employers, there are significant differences among employers in terms of which employees actually receive formal training.

Table 5

Determinants of the Proportion of Workers Trained†

Variable Names	Manufacturing		Non-Manufacturing	
	Estimate	*t-test*	*Estimate*	*t-test*
Establishment Characteristics				
Log [Capital/Labor]	.03	2.81**	.001	0.14
20-49 Employees	.03	0.48	.19	2.49**
50-99 Employees	.11	1.81*	.17	2.35*
100-249 Employees	.06	1.12	.06	0.81
250-999 Employees	.07	1.52	.06	0.87
Multi-Establishment Firm	.09	2.75**	-.02	-0.49
Employment Up	-.03	-0.67	-.06	-1.40
Employment Down	-.07	-1.66*	-.06	-1.32
Industry Controls	yes		yes	
Worker Characteristics				
Low Proficiency	.02	0.67	.06	1.42
Average Education	.04	1.60	-.005	-0.28
% Workers < 1 yr.	-.0002	-0.15	.001	1.26
Skills Demand Up	.13	3.93**	.08	2.01**
% Non-Managerial Workers Using Computers	.0002	0.36	.0004	0.78
% Minorities	-.0002	-0.31	-.0001	-0.19
% Women	.002	2.31**	.001	1.19
% Production Workers	.006	3.00**	-.004	-2.17**
% Supervisory Workers	.01	2.65**	-.004	-1.17
% Technical Workers	.005	2.13**	-.0005	-0.31
% Clerical/Sales Workers	.003	1.34	-.005	-2.48**
Unionized	-.009	-0.25	.04	0.82
Workplace Practices and Characteristics				
Use Benchmarks	.15	4.44**	.004	0.11
Use TQM	.18	5.36**	.12	3.12**
Have Job Sharing	-.04	-1.23	-.02	-0.45
0.87% Workers Rotated	.0005	0.86	.001	
% Workers in Self-Managed Teams	.001	1.73*	.00	0.06
# Organizational Levels	-.01	-1.34	-.004	-0.40
# Employees per Supervisor	-.001	-1.64*	-.001	-0.78
Research & Development	.02	0.58	.10	2.27**
Export	.05	1.38	.30	0.73
Birth Year of Establishment	.002	2.85**	.0002	0.23
(Equations also include a constant.)				
Number of Observations	890 (162 left censored)		624 (98 left censored)	
Log Likelihood	-551.72		-384.009	
Pseudo R^2	0.18		0.150	

† Tobit maximum likelihood estimates.
*Significance at the 10% level.
**Significance at the 5% level.

Other Dimensions of Training Practices

As reported by employers in the EQW-NES, more than 60 percent of the formal training paid for by establishments uses in-house rather than external training providers. However, for the 40 percent of training that is provided by vendors outside of the workplace, there is a large variety in the sources of trainers used by employers. Table 6 provides a distribution of the percentage of establishments using different types of training providers for their formal training programs. More than 50 percent of employers report using equipment suppliers or buyers for part of their formal training programs. Other training providers include private consultants, private industry councils, technical/vocational institutions (both for-profit and not-for-profit), community and junior colleges, and four-year colleges or universities. Only 12 percent use other government-funded training programs, and even fewer (5 percent) use unions.

Although the survey contained a question about the percentage of total annual labor costs spent on formal training programs, many employers in the survey answered this question with "Don't know." Most of the other employers reported that their annual formal training costs are less than 5 percent of total labor costs.[4] But the low response rate to this question (only 50 percent of employers reported a value for this question) makes it difficult to use this variable in any analysis. Although training costs in countries such as France and Australia are well documented, owing to mandated employer training taxes, our survey suggests that U.S. employers are not geared up to measure training costs because there are no clear and commonly agreed on accounting principles for determining those costs, especially indirect costs such as lost production. For example, many employers, as shown in Table 6, rely on outside equipment suppliers to provide their internal training. This generates one type of problem in quantifying training costs; for instance, if a business purchases a new photocopier machine, and the vendor, as part of the purchase price, agrees to train operators on site, determining the exact training expenditure is problematic.

An additional question in the EQW-NES that posed some difficulty for employers is the number of hours employees in different occupations spend in formal training. Because of the lower response rate to this question than to the question on the number of workers who receive training, we have not used hours of training in any of our analyses so far. For employers who do report positive hours of training, however, it is interesting to see that technical workers spend almost twice as much time in training as do production or even managerial employees (102 hours versus 60 hours per year). This suggests that greater attention should be paid to distinguishing the training experiences of technical workers from that of other production and non-production workers.

Finally, on average, 71 percent of formal training takes place during working hours. Interestingly, Barron and colleagues (1994) found that about 75 percent of formal training took place on site (presumably during working hours), and 25 percent occurred off site. The percentage of time spent in formal training during working hours could be recast as time in formal on-the-job training versus time in formal off-the-job training. Researchers, such as Bishop (1994), have found evidence that the returns to employer-provided off-the-job training are much higher than the returns to on-the-job training. We will explore this issue in the next section.

Table 6
Establishments Using Various Sources of Training†

Source	Percentage of Establishments
Equipment Suppliers or Buyers	50%
Private Consultants	36%
Private Industry Councils or Other Industry Associations	34%
Technical and Vocational Institutions	33%
Community and Junior Colleges	30%
Four-Year Colleges or Universities	20%
Other Government-Funded Training Programs	12%
Unions	5%

† Data are weighted.

The Impact of Human Capital Investments on Productivity

Few studies have been conducted in the United States on the impact of employer-provided training on productivity. Some of these studies (e.g., Barron et al. 1994 and Bishop 1994) that do link training and productivity used a subjective measure of productivity, such as the question, "On a scale of 1 to 4, how has your productivity changed over the last year?" or the measure of the productivity of the most recent hire relative to a fully trained worker, rather than using actual output or value-added to construct measures of labor productivity or total factor productivity. The main problem with subjective measures of productivity is that they are not comparable across firms or even within firms over time. They also do not allow the researcher to estimate rates of return to training versus other human resource practices.

Even given these caveats, there are some interesting findings associated with these subjective measures of productivity. Barron and colleagues (1987) and Bishop (1994), using data from the 1982 Employment Opportunity Pilot Project (EOPP) survey, and Bishop (1994), using data from the National Federation of Independent Businesses (NFIB) survey, all examine the impact of training in the first three months of employment on subjective measures of productivity for recent hires in establishments. In the EOPP survey of 659 establishments, training is divided into formal and informal training, with data collected on the duration/intensity of training, starting wages, starting productivity, current wages, and current productivity. The survey included a "productivity" measure, whereby employers were asked to rate the productivity of the most recent hire at the start of the job and currently on a scale from 0 to 100 (where 100 equals the maximum productivity rating any employee in a defined position could attain). This is not a nationally representative sample of employers, and the questions refer to the most recent new hires, not all incumbent workers in the establishment. In addition, by focusing just on newly hired employees, the survey over-samples workers in high-turnover jobs. We would expect *a priori* that these jobs would have less training attached to them.

The NFIB survey has a larger sample of 2,599 establishments (with a 25 percent response rate) than the EOPP survey, but it was designed to be similar to the EOPP survey and focuses on the employment experience of the most recent hire. In addition, the productivity measure used in this survey is similar to the one used in the EOPP survey. Bishop (1994), using data from this survey, concluded that employer-provided training raises this subjective productivity measure by almost 16 percent.

Other studies, such as Bartel (1989), have linked data from a survey of human resource management practices at the establishment level with firm-level data from Compustat on productivity and financial performance. Because most of the establishments in the survey used by Bartel were part of multi-establishment firms, however, there is a discrepancy in the unit of analysis of inputs and outcomes; that is, the Compustat data refer to the firm as a whole, not to specific establishments. This problem, along with a low overall response rate in the Human Resource Management survey used by Bartel (6 percent), limits the reliability of the productivity analysis. Nevertheless, Bartel found evidence that returns to training investments increase productivity by about 16 percent. In a follow-up study, Bartel (1992) examined a small longitudinal panel of manufacturing firms and found that lagged training investments, as opposed to current investments, yield positive effects on current productivity.

One of the unique features of the EQW-NES is that it is possible to examine outcome measures, such as productivity and wages, along with various measures of training and other workplace practices for a large, nationally representative sample of employers. The survey was designed to replicate the questions asked in the Annual Survey of Manufacturers about the dollar value of sales, receipts, or shipments; the book value of capital stock; and the cost of materials (including energy) used in production during the calendar year 1993. Given the survey design, these variables can then be augmented with worker characteristics (such as education and training), other establishment characteristics (such as the age of the capital stock), and workplace practices (such as TQM and benchmarking) to estimate a much richer production function than was possible before. In addition, because we collected sales, materials, and capital data specifically for the establishment, we are not forced to match establishment-level workplace practices with enterprise-level sales information.

In Table 7, we present results from a standard Cobb Douglas production function, where:

$$(1)\ \log(Y_i) = \text{constant} + a'*\log K_i + c*\log M_i + d*\log LH_i + e*\log LQ_i$$

Output Y_i is proxied by the dollar value of sales, receipts, or shipments for calendar year 1993 for establishment i, denoted by S_i; K_i is the 1993 book value of the capital stock; M_i is the total cost of goods and services used in the production of 1993 sales, including energy; LH_i are total labor hours for 1993; and LQ_i is a measure of labor quality, which we proxy with the average educational level of the establishment, denoted by ED. The vector X_i includes whether the establishment is part of a multi-establishment enterprise, the age distribution of the capital stock, the total number of workers trained in 1990 and 1993,[5] the percentage of formal training that occurs off the job, dummy variables for three specific types of training activities, the percentage of the full-time workforce that has been employed at the establishment for less than one year, whether grades or communication skills

are considered important for recruitment purposes, dummy variables for the use of TQM or benchmarking, a dummy variable equal to one if the establishment exports any sales of its principal product, a dummy variable equal to one if there is a research and development center anywhere in the enterprise, controls for capacity utilization, and whether the establishment is unionized. Because the values of sales, capital stock, and materials need to be deflated by the appropriate price deflators, we use dummy variables for the two-digit industrial classification of the establishment to account for this in our cross-sectional estimation.

Columns 1 and 3 of Table 7 report results for this unrestricted Cobb Douglas production function separately for the manufacturing and non-manufacturing sectors. Columns 2 and 4 impose two restrictions on the Cobb Douglas specification given in equation (1). The first restriction tests (in the spirit of Jorgenson and Griliches 1967) whether the coefficients on labor quality (average education) and labor hours are equal. If this is the case, then we can consider the labor input to be adjusted for quality, where the adjustment factor is proportional to the average educational level of the establishment. In other words, if d = e in equation (1), then the labor input can be rewritten as the product of labor hours times average education, as shown below in equation (2). This restriction is accepted at the 1 percent level, yielding a coefficient on quality-adjusted labor of 0.48 in manufacturing and 0.63 in non-manufacturing.[6] We then test to see if the restriction of constant returns to scale is accepted by our data (i.e., b + c + d = 1), which it is at the 1 percent level.[7] The restricted production function can be written as:

$$(2)\quad \log(S_i/(LH_i*ED_i)) = \text{constant} + a'*X_i + b*\log(K_i/(LH_i*ED_i)) + c*\log(M_i/(LH_i*ED_i))$$

As seen in Table 7, human capital is an important determinant of establishment productivity. The average educational level of the establishment has positive and significant effects in both the manufacturing and non-manufacturing sectors. The estimated coefficient in the unrestricted Cobb Douglas model implies that a 10 percent increase in average education (about one more year of schooling) will lead to a 8.5 percent increase in manufacturing productivity and a 12.7 percent increase in non-manufacturing productivity.

In the restricted model presented in columns 2 and 4 of Table 7, the implied coefficient on education would suggest that for a 10 percent increase in education, productivity would rise 4.9 percent in manufacturing and 5.9 percent in non-manufacturing. These values set the range of education's impact on productivity. Although the range is somewhat large, the impact of education on establishment productivity is substantial, especially in non-manufacturing. Because the non-manufacturing sector is expanding much more rapidly than manufacturing in the United States, this result may shed some light on the finding that the college/high school wage gap widened dramatically during the 1980s.

Training has a more complex impact on the productivity of establishments. Unfortunately, we are only able to obtain measures of the number of workers involved in training for two particular years: 1990 and 1993; this means that we do not have a measure of the accumulated stock of training for all workers and that our estimates of the impact of training are likely to underestimate the true returns. In addition, given our earlier findings of a complementarity between investments in training and the educational levels of workers, there may be problems of multi-colinearity. We find that the number of workers trained, especially in 1993,

Table 7

Determinants of Log Sales (Cobb Douglas Production Function)

Variable Names*	Manufacturing		Non-Manufacturing	
Dependent Variable	*Log (Sales)*	*Log (S/hours*ED)*	*Log (Sales)*	*Log (S/hours*ED)*
Constant	0.341	1.06**	-1.252	0.946**
	(0.317)	(7.335)	(-0.659)	(2.717)
Log Capital	0.25**	—	0.36**	—
	(11.304)		(9.957)	
Log (K/hours*ED)	—	0.25**	—	0.35**
		(11.311)		(9.959)
Log Materials	0.26**	—	0.06**	—
	(11.812)		(2.958)	
Log (M/hours*ED)	—	0.26**	—	0.06**
			(11.84)	(2.971)
Log Hours	0.47**	—	0.628*	—
	(12.45)		(10.948)	
Multi-Establishment Firm	0.13**	0.12**	-0.05	-0.02
	(2.257)	(2.183)	(-0.382)	(-0.163)
% Equip < 1 yrs. old.	-0.003	-0.003	0.005	0.005
	(-1.331)	(-1.288)	(1.249)	(1.327)
% Equip 1-4 yr. old	0.003**	0.003**	-0.0003	-0.0004
	(2.153)	(2.178)	(-0.155)	(-0.181)
Log Average Education	0.86**	—	1.29*	—
	(2.028)	(1.793)		
Log Trained 1993	-0.12	-0.12	0.08	0.07
	(-1.294)	(-1.356)	(0.39)	(0.355)
Log Trained 1990	0.09	0.09	-0.11	-0.09
	(0.994)	(1.030)	(-0.515)	(-0.425)
% Workers < 1 yr.	-0.003	-0.003*	-0.008**	-0.009**
	(-1.61)	(-1.692)	(-2.692)	(-2.875)
Unionized	-0.05	-0.06	0.35**	0.38**
	(-0.793)	(-0.952)	(2.494)	(2.722)
TQM	-0.02	-0.03	-0.01	-0.001
	(-0.347)	(-0.483)	(-0.121)	(-0.012)
Benchmark	0.03	0.032	0.08	0.09
	(0.539)	(0.558)	(0.621)	(0.721)
Above Capacity	0.218**	0.21**	0.37*	0.36*
	(2.114)	(2.063)	(1.816)	(1.796)
Below Capacity	-0.005	0.001	0.005	-0.009
	(-0.10)	(-0.011)	(0.047)	(-0.076)
Export	0.10*	0.10*	-0.05	-0.0
	(1.845)	(1.796)	(-0.338)	(-0.157)
Research & Development	-0.01	-0.01	-0.05	-0.04
Center	(-0.200)	(-0.133)	(-0.334)	(-0.265)
Birth Year of Establishment	0.001	0.001	0.0004	0.0002
	(1.26)	(1.428)	(0.164)	(0.087)
Industry Controls	yes	yes	yes	yes
N =	821	821	525	525
Adjusted R^2	0.8387	0.4331	0.6512	0.3814

† t-tests are given in parentheses.
*Significance at the 10% level.
**Significance at the 5% level.

has no apparent impact on productivity. In manufacturing, the number of workers trained during 1990 and 1993 is not statistically significant, although the point estimates suggest that current training lowers productivity while past training raises current productivity. This is similar to what we see happening with the age of the capital stock in manufacturing. Capital equipment less than one-year-old lowers productivity (although not statistically significantly), while capital stock aged 1 to 4 years raises current productivity. This suggests an adjustment story whereby adjusted costs associated with the introduction of new skills and capital into the workplace are followed by positive improvements in productivity.

When we include other dimensions of training, we see more compelling evidence of the impact of training on productivity. For manufacturing, the greater the proportion of time spent in formal off-the-job training, the higher is the productivity. This may have two causes. First, training workers outside working hours lowers the output loss associated with on-the-job training. Second, employers who train their workers off the job may be investing in more advanced and time-intensive skills development. Unfortunately, our survey does not allow us to explore this issue in more detail.

For non-manufacturing, the content of the training programs provided by employers appears to have an important impact on productivity. In particular, computer skills development has a significant and positive impact on establishment productivity, even controlling for industry. This finding is consistent with evidence presented by Krueger (1993) of higher wage premiums associated with workers who use computers on the job. This result suggests that it is not so much whether you train workers but rather *in what* you train them that affects establishment productivity.

Recruitment strategies of establishments also play an important role in their productivity. In non-manufacturing, establishments that cite grades as an important priority in hiring also have higher productivity. In manufacturing, the use of communication skills as a priority criterion in hiring decisions is almost significant at conventional levels in raising productivity. Table 8 shows the ranking in importance by employers of different applicant characteristics for recruitment and selection. What is striking about this table is how low a priority applicants' grades are for most employers. Yet, the results in Table 7, at least for non-manufacturing, suggest that those employers who do focus on grades experience significantly higher productivity than their competitors.

Other interesting results in Table 7 include the negative impact that high labor turnover has on productivity, especially for non-manufacturing. Although it is not news that turnover is high in non-manufacturing establishments, what this table suggests is that establishments pay a high price for this turnover in terms of lower sales. In non-manufacturing establishments, unionization has a positive and rather large effect on establishment productivity. At the same time, the use of TQM or benchmarking does not appear to have any impact on the current productivity of establishments, despite the fact that we found a significant link between these practices and the training practices of employers. One possible explanation for why these variables do not enter significantly is that we have not controlled for the timing of the introduction of these practices. If an employer had only just introduced these practices, we would expect to see a delay in the impact of these practices on productivity, just as we saw in the introduction of new physical capital. In addition, crude measures of the incidence of TQM or

Table 8
Relative Ranking of Factors in Making Hiring Decisions†

Applicant Characteristic	Rank
Attitude	4.6
Communication Skills	4.2
Previous Work Experience	4.0
Recommendations from	
Current Employees	3.4
Previous Employer Recommendation	3.4
Industry-Based Credentials	3.2
Years of Completed Schooling	2.9
Scores on Tests Administered as	
Part of the Interview	2.5
Academic Performance (Grades)	2.5
Reputation of Applicant's School	2.4
Teacher Recommendations	2.1

† These data are from answers to the following question: When you consider hiring a new non-supervisory or production worker (*front-line worker*), how important are the following in your decision to hire? Answers were scored on a scale of 1 to 5, where 1 equals not important or not considered and 5 equals very important.
Source: Lisa Lynch and Robert Zemsky. 1995. "First Results from the EQW National Employer Survey." EQW Results RE01, Philadelphia, PA: National Center on the Educational Quality of the Workforce.

benchmarking do not capture how these programs are actually being implemented. Perhaps what is most important is not the introduction of TQM but rather how it is introduced, when it is introduced, and how it is implemented. This issue has been examined much more closely by Ichniowski and colleagues (1993), who used more detailed industry information obtained in personal interviews and found a significant effect on productivity of high-performance work systems, depending on how they are implemented. Therefore, future data collection efforts should focus on obtaining more information on the content, timing, and implementation of programs, such as employer-provided training and TQM.

Although the results in Table 7 highlight the importance of human capital—especially education and certain types of employer-provided training—for establishment productivity, these findings have several limitations. First and foremost is the problem of endogeneity. The presence of unobserved establishment characteristics that are time invariant is likely to bias our estimated coefficients. Although we have a richer specification for the production function than most researchers, we still may not be capturing all establishment characteristics linked to productivity. Our estimated coefficients may also be affected by measurement error. If we had longitudinal data on the establishments in our survey, we could try to address the first problem of unobserved heterogeneity using within estimators to control for time-invariant, unobserved employer characteristics. Generalized Method of Moments (GMM) estimation of the model in the first differences would also allow us, in principle, to address the issue of measurement error. Longitudinal data on training inputs would also allow us to examine how the accumulation of training over time within a business affects current productivity. Finally, our results suggest that it is important to move beyond simple measures of the incidence of workplace practices, such as training or TQM, to understand how these types of workplace strategies and investments actually pay off for employers. We hope in future work to use longitudinal data from the Annual Survey of Manufacturers to address some of the endogeneity issues and to use a follow-up survey of the EQW-NES sample to obtain richer information on how workplace practices change over time.

Conclusions

Both the EQW-NES and the recent BLS survey of establishments show clearly that most employers in the United States provide some type of formal training program, although there is substantial variation by size and industry in the probability of providing formal training. In particular, even after controlling for a variety of worker and establishment characteristics, the smallest of employers are much less likely to provide formal training programs than employers with larger establishments. Regardless of size, those employers who have adopted some of the practices associated with high-performance work systems are much more likely to have formal training programs. In addition, employers who have made large investments in physical capital relative to the number of workers or who have hired workers with higher average educational levels are more likely to train workers within their establishments. This suggests that employer-provided training is a complement to rather than a substitute for investments in physical and human capital. In addition, there appears to be evidence of a virtuous circle in human capital investments, whereby employee investments in schooling are augmented by employer investments in training. Virtually all employers use informal training, so variations in the incidence of informal training across employers does not go far in explaining differences among employers in training strategies.

The types of training programs offered by businesses vary considerably across employer size and industry. When we estimate a descriptive logit on the probability of offering each of four different types of training programs, we find that smaller employers are less likely to offer computer, teamwork, or basic education training. In addition, average educational level and new workplace practices are positively related to "higher" skill development, such as computer and teamwork training.

Although most employers offer some type of formal training program, there is substantial variation across employers in terms of how "deeply" they train. The proportion of workers trained in the manufacturing sector is positively associated with investments in

physical capital and the average educational level of the employees. In both manufacturing and non-manufacturing, the occupational structure of the establishment and the use of new work practices such as TQM affect the proportion of workers trained. In addition, smaller establishments are likely to train a higher proportion of their employees, conditional on training at all.

Finally, there are significantly positive effects on establishment productivity associated with investments in human capital. Employers who hire better educated workers have appreciably higher productivity. This is true for both the manufacturing and non-manufacturing sectors. This result is consistent with the finding that there is a large wage premium associated with completing a college degree relative to a high school degree. In addition, those employers in the non-manufacturing sector who use a measure of educational quality (grades) in their recruitment of new production workers or front-line workers experience higher productivity than their competitors. The impact of training investments by employers differs according to their nature, timing, and location. Our results suggest that formal training outside working hours has a positive effect on productivity in manufacturing, while computer training raises the productivity of non-manufacturing establishments.

Endnotes

[1] For example, Delany, Lewin, and Ichniowski (1989) had a response rate of 6.5 percent; Lawler, Mohrman, and Ledford (1992) had a response rate of 32 percent; the National Federation of Independent Businesses survey in 1987 had a 25 percent response rate (see Bishop 1994 for a review of this survey); the Small Business Administration survey of establishments in 1992 conducted by Barron, Berger, and Black had a 50 percent response rate; and the National Organization Survey (1991) of establishments had a 50 percent response rate (see Knoke et al. 1993). Nationally representative surveys of establishments with response rates closer to the EQW-NES rate include the BLS 1994 Training Survey, which had a response rate of 70 percent, and a 1992 survey of 875 establishments with more than 50 employees conducted by the University of Massachusetts Center for Survey Research and described in Osterman (1994), which had a response rate of 65 percent.

[2] The occupational categories used in the survey for the manufacturing sector included managerial and professional workers, supervisors, technical workers, clerical/office/sales workers, and production workers. Similar categories were used for the non-manufacturing sector, except that the last two categories were clerical/office workers and sales/customer service or other front-line workers.

[3] We ran similar logits on all the other types of training programs but only report these four types because they appeared to be representative of the range of possible offerings by employers.

[4] This is similar to the mean value of percentage of labor costs spent on recruitment, 4.6 percent.

[5] We also have tried specifications in which training is entered as the proportion of workers trained, but the reported results do not change.

[6] We do not report the results for the equation estimated only imposing the restriction of the equality of coefficients on labor hours and labor quality for reasons of space. Although it appears at first glance in Table 7 that it would be difficult to accept the restriction that the coefficients on labor hours and education are the same, the standard error on education is relatively large, even though the coefficient is statistically significant in both columns 1 and 3.

[7] Most studies on the determinants of productivity of U.S. establishments using cross-sectional data find constant returns to scale. One difference between our results and those of other studies is that we have found the coefficient on materials to be much lower. We believe this is because respondents had much more difficulty answering this question in the telephone interview than the questions on sales, capital, or labor. Therefore, there is significant measurement error for materials. In future work, subject to availability, we hope to use data from the Annual Survey of Manufacturers to correct the materials data for at least a subset of our observations.

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APPENDIX A

EQW National Employer Survey: Response Rates†

	Percentage	Number of Cases
Manufacturing Sector		
Completed + All Partials‡	75.0%	1831
Completed + Workplace Partials	70.4%	1728
Completed Interviews	66.0%	1621
Non-Manufacturing Sector		
Completed + All Partials	69.4%	1516
Completed + Workplace Partials	66.2%	1445
Completed Interviews	60.6%	1324

†Empirical analysis of the determinants of the probability of refusing to participate in the survey showed no significant impact of establishment size or industry on the probability of responding for the non-manufacturing sector. For manufacturing, establishments in the largest size category (1,000 employees or more) were slightly more likely to refuse to participate in the survey than establishments in all other size categories.

‡Since all interviews had to be completed by the end of September 1994, some of the surveys were not totally completed. The survey was divided into two main sections (and allowed for multiple respondents): the first on establishments' sales and financial information, and the second on employment practices. The bulk of the survey questions were contained in the employment practices section of the survey. Therefore, the final sample includes some partial interviews. Our analysis focuses on the completed plus workplace partial interviews.

APPENDIX B
Distribution of Sample by Industry

Establishment Industry	Unweighted	Weighted
Manufacturing		
Food and Tobacco (SIC 20, 21)	5%	2%
Textile and Apparel (SIC 22, 23)	4%	2%
Lumber and Paper (SIC 24, 26)	6%	2%
Printing and Publishing (SIC 27)	5%	2%
Chemicals and Petroleum (SIC 28, 29)	6%	1%
Primary Metals (33)	6%	2%
Fabricated Metals (34)	5%	2%
Machinery and Computers, Electrical Machinery, and Instruments (SIC 35, 36, 38)	6%	4%
Transportation Equipment (SIC 37)	6%	1%
Miscellaneous Manufacturing (SIC 25, 30, 31, 32, 39)	6%	6%
Non-Manufacturing		
Construction (SIC 15-17)	5%	7%
Transportation Services (SIC 42, 45)	4%	3%
Communications (SIC 48)	2%	2%
Utilities (SIC 49)	4%	1%
Wholesale Trade (SIC 50, 51)	5%	11%
Retail Trade (SIC 52-59)	4%	34%
Finance (SIC 60-62)	4%	4%
Insurance (SIC 63, 64)	4%	2%
Hotels (SIC 70)	5%	2%
Business Services (SIC 73)	4%	7%
Health Services (SIC 80)	4%	8%

Total unweighted observations = 3173

APPENDIX C
Distribution of Sample by Establishment Size

Establishment Employment	Unweighted	Weighted
20-49 Employees	16%	53%
50-99 Employees	17%	23%
100-249 Employees	20%	14%
250-999 Employees	30%	8%
1000 or More Employees	17%	2%

Total unweighted observations = 3173

APPENDIX D

Selected Mean Values for Tables 7 and 8 (Unweighted)

Variable Names	Manufacturing	Non-Manufacturing
Multi-Establishment Firm	65%	61%
Average Education	12.5 yrs.	13 yrs.
% Employees with Tenure < 1 yr.	12%	19%
Unionized	35%	22%
Proportion Trained 1993	49%	47%
% Formal Training Outside Working Hours	28%	28%
Provide Computer Training	78%	68%
Provide Teamwork Training	67%	56%
Provide Supervisor Training	83%	75%
Grades Priority in Recruitment	19%	15%
Communication Skills Priority in Recruitment	68%	79%
Above Capacity	7%	9%
Below Capacity	37%	39%
Use Benchmarks	38%	31%
Use Total Quality Management	56%	33%
Export	63%	19%
Have Research & Development Center	62%	23%

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